

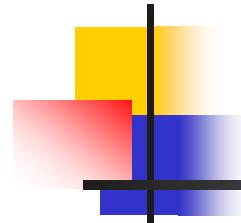
NuMI Offaxis Totally Active Detector

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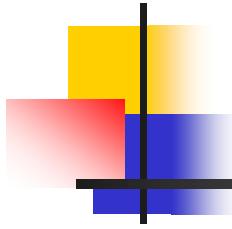
Fermilab Offaxis Meeting

February 8, 2004



Rough Numbers - Mass

- Current design scintillator volume, use:
 $2.9\text{cm} \times 14.4\text{m} \times 29.2\text{m} \times 800 \text{ planes} = 9890\text{m}^3$
use for density 0.838 g/cc (miniBooNE Witco)
This gives 8.29 kt of scintillator



Possible FOM Improvement

- Peter's most recent calculation:

Final likelihood cut	1.1	7.5	9.1	106
Efficiency/rejection	5.9×10^{-5}	1.3×10^{-3}	2.3×10^{-2}	0.18

$$\text{Figure of Merit} = \text{Signal}/\text{Background} = 25.3/0.4$$

Assume:

Nue efficiency $\rightarrow 0.40$

Nue beam (bknd) up by $(0.4/0.18) \times 0.8$ (energy res)

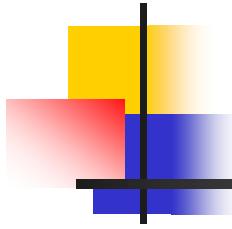
NC and numu CC down by a factor of 3

Yields FOM = 52.4 \rightarrow Equivalent mass lower by 4.37

Yields mass of $50/4.37 = 11.44$ kt \rightarrow 1.38 more scint

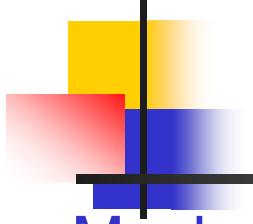
Cost Comparison

Item	RPC 2-D readout	RPC 1-D readout	Solid scintillator	Liquid scintillator
Absorber	12.6	12.6	13.3	12.1
Active Detector M&S	40.7	36.2	57.9	29.2
Active Detector labor	16.3	14.5	20.3	7.3
Readout and DAQ	8.3	4.5	6.1	5
Shipping	2.2	2.2	3	1
Installation	2.6	2.6	5.8	4.7
Enclosure	25	25	28	31
Sub-total	107.7	97.6	134.4	90.3
EDIA (25%)	26.9	24.4	33.6	22.6
Project management (8%)	8.6	7.8	10.8	7.2
Overhead (20%)	21.5	19.5	26.9	18.1
Contingency (40%)	43.1	39.0	53.8	36.1
Total	207.9	188.4	259.4	174.3



Cost Comparison

- Scale the following:
 - Active Detector M&S - \$29.2 M
 - Active Detector Labor - \$7.3 M
 - 60% of Readout and DAQ - \$3 M
- Total is \$39.5 M, excess for extra scintillator = $39.5 \times 0.38 = \$15.0$ M
- We save:
 - Particle Board - \$12.1 M (now more, shipping?)
 - 50% of Building (detector volume is ~5.2 less) - \$15.5 M
 - Veto shield (no need) - ~\$2 M
- Cost saving $\$29.6 - \$15.0 = \$14.6$ M (out of \$90.3 M)



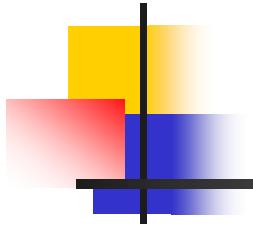
Construction Issues

- **Mechanical assembly**

- The modules are in static (unstable) equilibrium - no forces
- Might start with bookend, glue together successive layers
- Might use packaging steel bands periodically

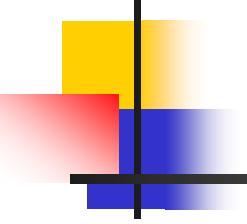
- **Electrical / optical issues**

- Density of cells about factor of 5 higher now
- Might make sense to make common boxes, serving ~20 cells, for APD's, electronics, cooling, etc - savings in cables, connectors, installation
- Fibers from manifold would extend for ~40 cm (pig tail) before terminating in a connector - no difficult alignment issues
- Maybe conventional cooling would make more sense



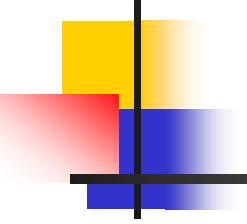
Physics Improvements

- Could measure θ_{23} much better - quasielastics are well measured and constrained
- Δm^2_{23} could be measured better, less uncertainty on energy scale
- Could set better limits on sterile ν contribution - should have subset of very clean NC events



Other advantages

- Cosmic ray background drastically reduced; hence need for overburden is less likely
- Not restricted by particle board sizes; more freedom in choice of detector dimensions
- Fiber, electronics cost proportional to area of cell -> more freedom in choice of cell dimensions eg maybe 2.8x3.9 is better than 3.9x2.8 (more light/cell, better transverse segmentation)
- Near Detector becomes much more powerful now in measuring rates and backgrounds



Conclusions

- On the first glance this looks like it might be promising
- Maybe one can shoot it down right away
- If not, we should simulate this kind of configuration with a view of understanding performance and also to try to find optimum parameters